

## Research Paper

## Neurodevelopmental Handling Skills for Parents of Children With Cerebral Palsy: A Randomized Control Trial



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**ABSTRACT**

**Objectives:** To investigate whether group training of neurodevelopmental handling skills for parents of children with cerebral palsy (CP) effectively empowers parents and improves children's functional mobility, and whether any benefit is maintained.

**Methods:** In this randomized single-blind clinical trial, fifty children with spastic CP aged 3-10 years were enrolled. The experimental group received 8 weeks of handling and positioning skills training in addition to usual therapy, whereas the control group received usual therapy alone. Gross motor function, functional mobility, and family empowerment were evaluated at baseline and at 4, 8, 12, and 16 weeks post-intervention by a blinded assessor.

**Results:** After controlling for pre-intervention values, no statistically significant differences in gross motor function or mobility function were observed between the control and intervention groups. However, family empowerment scores were significantly higher in the intervention group at various time points throughout the study.

**Discussion:** Group training in handling skills improved family empowerment with sustained positive effects.

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## Highlights

- The neurodevelopmental approach is a fundamental strategy in addressing motor development for individuals with CP, with handling techniques serving as a primary therapeutic modality.
- No significant differences in gross motor function or mobility function after group neurodevelopmental handling skills intervention were found.
- Group training in handling skills significantly improved parental abilities of children with CP.

## Plain Language Summary

The current study aimed to evaluate the effectiveness of group training in handling skills for parents of children with cerebral palsy (CP) on improving functional mobility, a vital aspect of independent living. This randomized controlled trial, conducted between 2023 and 2024, included 46 children with CP aged 3-10 years who were assigned to either an intervention group or a control group. The intervention group received specialized group training sessions in addition to routine occupational therapy interventions. Outcome measures included assessments of gross motor function, mobility function, and family empowerment. Results showed that group training significantly improved family empowerment in the intervention group, with sustained positive effects throughout the study. No significant differences were found in gross motor function or mobility function between the control and intervention groups. These findings suggest that group training in handling skills for parents of children with CP can empower families and contribute to overall family well-being, but may not necessarily improve the children's physical functioning. The average age of the children was 7.02 years, with a balanced distribution of boys and girls. Parents' average age ranged from 35.54 to 40.40 years, and their education levels varied, with an average of 8.84 years for fathers and 8.8 years for mothers. Twenty-four percent of children exhibited a gross motor function classification system (GMFCS) level 5. This study highlights the importance of supporting families of children with CP and demonstrates that group training in handling skills can be an effective strategy for enhancing family empowerment. Further research is needed to investigate other potential interventions that may improve the physical functioning of children with CP.

## Introduction

Cerebral palsy (CP) is a group of motor disorders often accompanied by sensory, cognitive, communication, perception, and behavioral issues, as well as epilepsy, nutrition, dysphagia, and oral motor dysfunction [1]. The neurodevelopmental approach is a fundamental strategy in addressing motor development for individuals with CP, with handling techniques serving as a primary therapeutic modality [2]. These techniques aim to enhance neurotransmitter input to the brain, fostering the creation of neural maps through stimulating proprioception and facilitating the neurodevelopmental process [3]. Therapists employ specialized manipulation techniques to reinforce postural reactions and movements in children, providing a more natural sensory and motor experience alongside therapeutic activities [4].

Handling and positioning are critical components of the neurodevelopmental approach because they help facilitate natural movement patterns, improve postural

control, and enhance motor learning. Proper positioning and handling techniques can improve alignment, stability, and increase mobility [3, 5]. This approach considers the unique needs and abilities of each child, with the techniques used in handling and positioning being tailored to the specific disorders and goals of the individual [2, 6].

The desired output resulting from the application of the neurodevelopmental approach and its various techniques is often used in the clinical environment by therapists, which is possible only during a few limited sessions during the week. Children with CP spend significant hours of the day in a non-therapeutic environment with their families, highlighting the crucial role family participation plays in implementing prescribed exercises by the therapist outside the therapeutic environment, allowing children with CP to continually benefit from necessary interventions [7].

Sharif Azar et al. (2015) conducted a study in the same field that pointed to the greater effectiveness of home-based interventions compared to interventions based in medical centers [8]. Many studies have been conducted, particularly among Iranian families with children with CP, which indicate the necessity of empowering this group of parents, which can be achieved with positive and all-round support from occupational therapists [7, 9-12]. Empowerment can be interpreted as an individual's capacity to take responsibility for one's life [13]. Parents of children with CP are affected by their child's health conditions in many aspects, such as time management, occupational balance, and quality of life [7, 12, 14]. These parents require positive support and increased satisfaction with their child's treatment sessions to better manage existing conditions [11, 15]. Studies show that guiding mothers with children who have CP in the field of occupational implementation can be effective in increasing their self-sufficiency, and, as a result, empowering them through intervention [16]. A study conducted provided a family empowerment program to families with children with CP and achieved similar results [17].

Despite these previous studies, there remains a need to investigate the effectiveness of group training in handling skills for parents of children with CP. This study aims to address this gap by examining the impact of such training on children's functional mobility, a critical aspect of independent living. The specific research questions are:

- 1) Is 8 weeks of group handling training to parents of children with CP effective at improving children's gross motor function and mobility function?
- 2) Are any benefits maintained 8 weeks after the period of intervention?
- 3) Can group handling training empower parents?

By addressing these questions, this study can contribute to the existing literature on CP interventions, potentially leading to improved therapeutic approaches and better outcomes for children with CP and their families.

## Materials and Methods

### Study design and participants

Our single-blinded, randomized controlled trial was conducted between 2023 and 2024 at the Tavanyab Charity Center in Tehran City, Iran. Forty-six children with spastic CP aged 3-10 years were recruited through referrals and included in the study. An independent recruiter screened the participants, performed initial measurements, and stratified them into three classes based on the

gross motor function classification system (GMFCS): GMFCS 1-2, GMFCS 3, and GMFCS 4-5. Participants were then randomly assigned to either the control or intervention group, and groups were homogenized based on GMFCS level to minimize the impact of random variables in statistical analysis. We included two additional participants per group to account for potential dropouts. The inclusion criteria comprised families with sufficient command of the Persian language, effective presence of the mother during intervention, and no plans for specialized surgery during the intervention period. The exclusion criteria included vision problems, unwillingness to continue participating in the study, and the occurrence of illness or other issues during the intervention.

### Study intervention

The control group received 8 weeks of routine occupational therapy interventions delivered by an occupational therapist with at least one year of pediatric physical disability experience. In addition to routine interventions, the intervention group received specialized group training, which involved 5 workshop sessions addressing family awareness and appropriate handling and positioning techniques. The control group was offered specialized group training after the trial's completion.

Outcomes were measured at baseline (before the intervention), 1 month after the intervention start, at the end of the intervention (the eighth week), and twice under follow-up (1 and 2 months after intervention completion) by a blinded assessor. Post-training, parents implemented acquired skills at home for 2 months, with continuous monitoring via phone calls and face-to-face interactions.

### Group training sessions

The sessions were as follows:

- 1) Overview session: It covered the nature, causes, types, and symptoms of CP, functional levels, prognosis, associated disorders, and common occupational therapy interventions.
- 2) Discussion session: It facilitated a forum for parents to discuss challenges related to handling their children, musculoskeletal pains, and disruptions to their quality of life.
- 3) Functional problems session: It explored children's functional problems, inviting parents to articulate challenges faced in various occupational areas.
- 4 & 5) Intervention preparation sessions: It was based on analyses from prior discussions, the researcher formulated targeted interventions presented in subsequent workshops, and parents practiced handling and positioning techniques.

### Assessment tools and measures

The gross motor function measure-88 (GMFM-88), developed by Russell et al. (1989), serves as a reliable instrument for evaluating the gross motor performance of children [18]. It comprises five distinct subscales: lying and rolling, sitting, crawling and kneeling, standing, and walking, running, and jumping. Each item within these subscales is assigned a score ranging from 0 to 4, indicative of varying degrees of motor proficiency. Salehi et al. (2015) validated and established the tool's reliability, reporting intra-examiner and inter-examiner correlation coefficients of 0.99 and an internal consistency Cronbach  $\alpha$  ranging from 0.78 to 0.94 [19].

The pediatric evaluation of disability inventory (PEDI), developed by Haley (2000), assesses children's performance across three scales: functional skill, caregiver assistance, and modification [20]. The self-care dimension of the functional skill scale, containing 73 items, measures the child's ability to perform daily activities independently. Grading options include zero and one [21]. Abbasabadi et al. (2015) confirmed the questionnaire's reliability, reporting Cronbach  $\alpha$  values between 0.94 and 0.97 and test re-test reliability of 0.97 for the functional skill scale and 0.96 for the modifications scale [22].

The family empowerment scale (FES), introduced by Koren et al, measures family empowerment. Comprising three subscales (family, service system, and community/political), this tool scores items on a scale from 1 to 5 [23]. Rajabi and Zolmajd validated and confirmed the reliability of the Persian FES through a test re-test method, reporting reliability coefficients of 0.86 and Cronbach  $\alpha$  of internal consistency of 0.94 [24].

The GMFCS is an observational standard classification system designed to categorize children with CP up to the age of 18. This classification is based on their present gross motor abilities, limitations in gross motor function, and the necessity for assistive technology and wheeled mobility. The system stratifies individuals into 5 distinct levels, where level 1 signifies maximum independence, and level 5 indicates the minimum level of independence in performance [25]. The GMFCS has been translated and validated in Iran by Dehghan et al. (2011), affirming its applicability and relevance in diverse settings [26]. The demographic information questionnaire utilized in this study systematically gathers vital demographic data, encompassing the child's age and gender, as well as parental details such as age and education level.

### Statistical analysis

All measures were analyzed using an intention-to-treat analysis. Descriptive statistics were calculated for all variables at 5 time points: Weeks 0, 4, 8, 12, and 16. Descriptive statistics, including the calculation of mean and standard deviation for quantitative variables and frequency and percentage for qualitative variables, were employed to present a comprehensive overview of data distribution and changes. The normal distribution of quantitative variables was assessed using the Shapiro-Wilk test.

Analysis of covariance (ANCOVA) was utilized to evaluate the significance and impact of the intervention on the studied outcomes. This statistical method enables the comparison of average scores between the control and intervention groups during and after the intervention while controlling for influential variables and baseline values.

The effect size, measured through partial eta square ( $\eta_p^2$ ), was computed and reported for the ANCOVA model. Interpretation of  $\eta_p^2$  values is as follows: 0.01-0.06 represents a small effect size, 0.06-0.14 indicates a medium effect size, and values exceeding 0.14 signify a large effect size.

Statistical analysis was conducted using SPSS software, version 16, with a predetermined significance level of 0.05.

## Results

### Individual and clinical characteristics of study participants

A total of 125 children with CP were screened for eligibility (Figure 1). Of these, 75 were excluded and 50 invited and were enrolled in the trial. Of these, 25 were randomized to the experimental group and 25 to the control group.

Table 1 presents the individual and clinical characteristics of the children and their parents involved in the study. The average age of the studied children was  $7.02 \pm 2.27$  years, with a gender distribution of 50.0% boys. Fathers had an average age of  $40.40 \pm 7.50$  years, mothers had an average age of  $35.54 \pm 7.75$  years, and both parents had an average education level of  $8.84 \pm 4.76$  and  $8.8 \pm 4.89$  years, respectively.

**Table 1.** Demographic characteristics of participants in the intervention and control groups (n=25)

Variables	No. (%) / Mean ± SD		
	Intervention	Control	
Child's gender <sup>‡</sup>	Girl	11(44)	14(56)
	Boy	14(56)	11(44)
GMFCS level <sup>§</sup>	1	5(20)	4(16)
	2	7(28)	7(28)
	3	3(12)	4(16)
	4	4(16)	4(16)
	5	6(24)	6(24)
Child's age (y) <sup>†</sup>	7±2.35	7.05±2.25	
Father's age (y) <sup>†</sup>	40.8±6.57	40±8.45	
Mother's age (y) <sup>†</sup>	37.04±7.17	34.04±8.15	
Father's education (y) <sup>†</sup>	9.96±4.2	7.72±5.1	
Mother's education (y) <sup>†</sup>	9.64±4.46	7.28±5.1	

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Note: The table presents the distribution of variables in the intervention and control groups, including child's gender, GMFCS level, child's age, father's age, mother's age, father's education, and mother's education. Statistical analyses were conducted using independent t-tests (†) for continuous variables and chi-square tests (§) or Fisher's exact tests (§) for categorical variables.

Among the 50 children studied, distributions were observed in terms of GMFCS levels. For instance, 24% of children exhibited GMFCS level 5. Table 1 demonstrates the homogeneity between the control and intervention groups across all individual and clinical variables, ensuring comparable participant characteristics in both groups. Data for 5 measurement occasions are presented in Table 2 for all outcome measures.

### Family empowerment (FES) total score and subscale scores)

**FES total score:** The intervention group exhibited significantly higher FES total scores 1 month post-intervention ( $\eta^2_p=0.082$ ,  $P=0.047$ ), persisting at 2 months ( $\eta^2_p=0.116$ ,  $P=0.017$ ), 1-month post-intervention conclusion ( $\eta^2_p=0.160$ ,  $P=0.004$ ), and 2 months post-intervention conclusion ( $\eta^2_p=0.284$ ,  $P<0.001$ ). These findings underscore the sustained positive influence of the intervention on the FES total score.

**Family subscale scores:** Covariance analysis, adjusting for pre-intervention values, revealed no statistically significant differences in family subscale scores

one month ( $\eta^2_p=0.062$ ,  $P=0.086$ ) and two months ( $\eta^2_p=0.070$ ,  $P=0.066$ ) after initiation. However, post-intervention saw a notable increase in the intervention group's family subscale scores. One-month post-intervention witnessed a substantial 4.72-unit rise ( $\eta^2_p=0.214$ ,  $P<0.001$ ), persisting at two months with a 5.89-unit increase ( $\eta^2_p=0.288$ ,  $P=0.001$ ), emphasizing the intervention's positive impact on family-related outcomes.

**Service systems subscale scores:** While one-month post-intervention showed no significant difference ( $\eta^2_p=0.066$ ,  $P=0.075$ ), the intervention group demonstrated a marked increase in service systems subscale scores compared to the control group ( $\eta^2_p=0.178$ ;  $P=0.002$ ; 95% CI, 1.76%). This superiority persisted at 1 month ( $\eta^2_p=0.103$ ,  $P=0.024$ ) and two months ( $\eta^2_p=0.262$ ,  $P<0.001$ ), highlighting the positive influence of the intervention on service systems-related outcomes.

**Table 2.** Effects of handling skills training on family empowerment and motor function

Variables	Time	Mean±SD		MD <sup>#</sup>	95% CI	ANCOVA		
		Group				F	P	η <sup>2</sup> <sub>p</sub>
		Intervention	Control					
Family	T <sub>0</sub>	46.5±8.2	42.6±7	-	-	-	-	-
	T <sub>1</sub>	46.8±6.2	42.5±5.5	2.37	-0.35, 5.09	3.08	0.086	0.062
	T <sub>2</sub>	46.1±6.4	41.7±5.3	2.60	-0.18, 5.38	3.54	0.066	0.070
	T <sub>3</sub>	48.2±6	41.6±5.4	4.72	2.07, 7.38	12.82	<0.001*	0.214
	T <sub>4</sub>	48.6±5.7	41.1±5.4	5.89	3.17, 8.61	18.98	<0.001*	0.288
Service system	T <sub>0</sub>	46.6±7.2	44.7±6.4	-	-	-	-	-
	T <sub>1</sub>	47±6	43.5±5.8	2.61	-0.27, 5.5	3.31	0.075	0.066
	T <sub>2</sub>	47.8±6	42.1±6.3	4.77	1.76, 7.77	10.21	0.002*	0.178
	T <sub>3</sub>	47.1±5.5	43±6.2	3.18	0.43, 5.93	5.41	0.024*	0.103
	T <sub>4</sub>	49±5.3	42.3±6.4	5.72	2.91, 8.54	16.73	<0.001*	0.262
Community/Political	T <sub>0</sub>	34.9±7.3	31.3±5.3	-	-	-	-	-
	T <sub>1</sub>	38.3±5.5	33.7±4.8	2.66	0.37, 4.94	5.47	0.024*	0.104
	T <sub>2</sub>	37.2±5.2	33.2±4.9	2.01	-0.25, 4.27	3.19	0.080	0.064
	T <sub>3</sub>	38.5±4.9	33.8±5.1	3.00	0.65, 5.35	6.59	0.014*	0.123
	T <sub>4</sub>	40.6±4.9	34.2±5.6	4.70	2.07, 7.34	12.88	<0.001*	0.215
Total family empowerment	T <sub>0</sub>	128±20.9	118.5±15.5	-	-	-	-	-
	T <sub>1</sub>	132±14.3	119.6±14.3	7.10	0.11, 14.09	4.17	0.047*	0.082
	T <sub>2</sub>	131.1±15.1	117±15.1	8.68	1.65, 15.7	6.17	0.017*	0.116
	T <sub>3</sub>	133.8±15.5	118.4±15.5	9.89	3.25, 16.54	8.98	0.004*	0.160
	T <sub>4</sub>	138.2±15.2	117.6±16.2	15.34	8.19, 22.5	18.61	<0.001*	0.284
PEDI total score	T <sub>0</sub>	23.1±20.9	21.4±22.7	-	-	-	-	-
	T <sub>1</sub>	23.3±20.8	21.2±22.6	0.41	-0.14, 0.95	2.22	0.142	0.045
	T <sub>2</sub>	23.2±21.1	21.4±22.7	-0.01	-0.79, 0.78	<0.01	0.991	<0.001
	T <sub>3</sub>	23.4±21.3	21.6±22.6	0.07	-0.61, 0.76	0.04	0.834	<0.001
	T <sub>4</sub>	23.7±21.4	21.4±21.9	0.66	-0.75, 2.08	0.89	0.350	0.019
Lying and rolling	T <sub>0</sub>	92.4±14.9	86.3±28.4	-	-	-	-	-
	T <sub>1</sub>	92.9±13.8	88.9±27.6	-1.65	-5.71, 2.41	0.67	0.419	0.014
	T <sub>2</sub>	92.9±14.6	89.4±27.4	-2.10	-6.97, 2.77	0.75	0.391	0.016
	T <sub>3</sub>	93.7±13.4	88.3±27.0	0.01	-4.58, 4.59	<0.01	0.998	<0.001
	T <sub>4</sub>	93.2±12.7	90±25.8	-1.86	-6.66, 2.93	0.61	0.439	0.013

Variables	Time	Mean±SD		MD <sup>#</sup>	95% CI	ANCOVA		
		Group				F	P	$\eta^2_p$
		Intervention	Control					
Sitting	T <sub>0</sub>	79±38.7	71.3±40.5	-	-	-	-	-
	T <sub>1</sub>	79.4±37.9	71.7±41	0.38	-5.89, 6.65	0.02	0.904	<0.001
	T <sub>2</sub>	79.2±37.1	72±39.9	-0.07	-5, 4.86	<0.01	0.977	<0.001
	T <sub>3</sub>	81±34.4	71.8±39.6	2.20	-2.58, 7	0.86	0.359	0.018
	T <sub>4</sub>	80.3±35.5	72.7±39	0.51	-4.45, 5.46	0.04	0.838	<0.001
Crawling and kneeling	T <sub>0</sub>	76.4±39.7	60.1±43	-	-	-	-	-
	T <sub>1</sub>	73.3±40.8	58.6±45.6	-1.68	-8.18, 4.8	0.27	0.604	0.006
	T <sub>2</sub>	76.4±40.3	59.6±43.7	0.64	-4.8, 6.08	0.06	0.813	0.001
	T <sub>3</sub>	74.2±40.4	61.5±43.3	-3.29	-9.4, 2.82	1.17	0.285	0.024
	T <sub>4</sub>	75.1±39.7	61.6±45.2	-2.65	-9.07, 3.77	0.69	0.411	0.014
Standing	T <sub>0</sub>	54.2±39.5	48.5±45.5	-	-	-	-	-
	T <sub>1</sub>	54.3±38.2	48.3±43.7	-1.78	-7.91, 4.35	0.34	0.56	0.007
	T <sub>2</sub>	57.1±38.4	49.2±44.1	0.25	-7.23, 7.73	0.01	0.946	<0.001
	T <sub>3</sub>	56.9±40.9	50.9±44.2	-1.76	-10.04, 6.51	0.18	0.670	0.004
	T <sub>4</sub>	54.6±37.7	50.4±44.4	-3.33	-11.52, 4.86	0.67	0.418	0.014
Walking, running and jumping	T <sub>0</sub>	40.2±40.3	26.2±32.4	-	-	-	-	-
	T <sub>1</sub>	41.4±38.5	29.1±33.7	-1.17	-5.95, 3.6	0.24	0.624	0.005
	T <sub>2</sub>	43.2±38.6	29.4±34.1	0.23	-4.9, 5.41	0.01	0.928	<0.001
	T <sub>3</sub>	42.9±38.4	27.7±31.4	2.08	-2.59, 6.75	0.81	0.374	0.017
	T <sub>4</sub>	43.8±38.2	30.2±33.4	0.28	-4.96, 5.52	0.01	0.914	<0.001
Total gross motor function	T <sub>0</sub>	68.4±31.2	58±33.7	-	-	-	-	-
	T <sub>1</sub>	68.3±30.6	59.3±33.9	-1.26	-5.06, 2.53	0.45	0.506	0.009
	T <sub>2</sub>	69.8±30.7	59.9±33.4	-0.30	-4.37, 3.77	0.02	0.883	<0.001
	T <sub>3</sub>	69.7±30.4	60±33	-0.31	-4.4, 3.78	0.02	0.880	<0.001
	T <sub>4</sub>	69.4±29.9	61±33.3	0.00	-	0.49	0.487	0.010

Abbreviations: CI: Confidence interval; ANCOVA: Analysis of covariance;  $\eta^2_p$ : Partial eta squared

\*P<0.05, #Adjusted for pre-intervention values.

Note: Effect sizes were interpreted as small (0.01-0.06), medium (0.06-0.14), and large (>0.14).

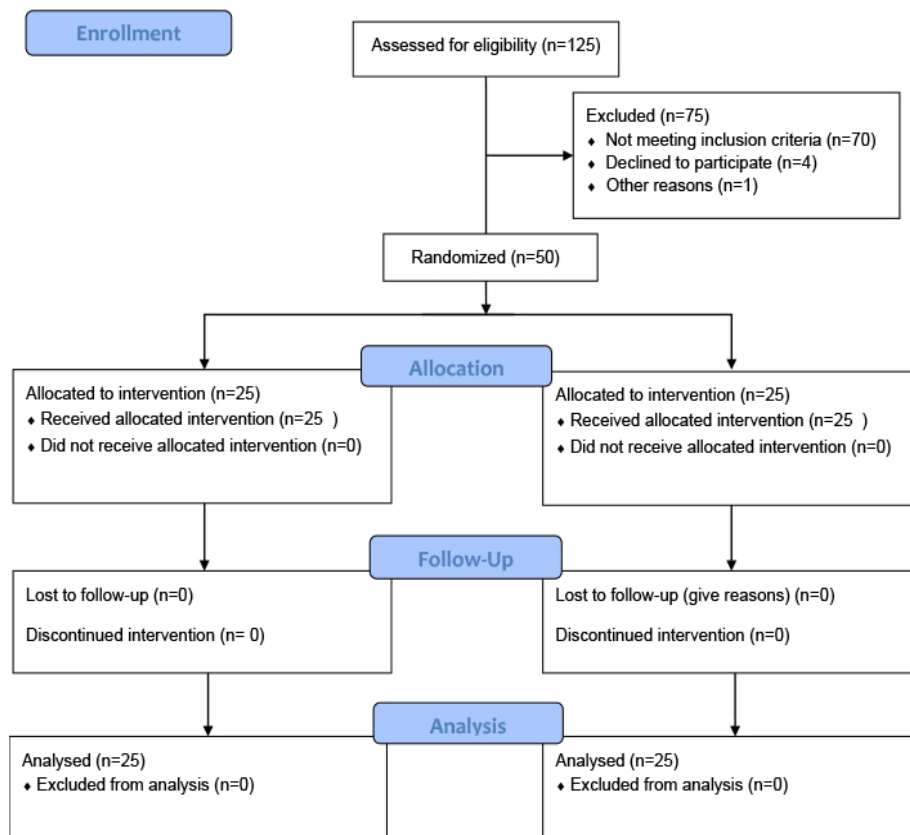


Figure 1. Design and flow of participants through the trail

Community/political subscale score: Covariance analysis, adjusting for pre-intervention values, revealed a significant increase in the intervention group’s community/political subscale scores 1-month post-intervention ( $\eta^2_p=0.104$ ,  $P=0.024$ ), persisting at 1 month ( $\eta^2_p=0.123$ ,  $P=0.014$ ) and 2 months ( $\eta^2_p=0.215$ ,  $P<0.001$ ) after intervention conclusion. The intervention consistently led to significantly higher scores compared to the control group, indicating positive influence.

**Mobility function (PEDI) total score**

PEDI total score: Covariance analysis showed no significant differences in total PEDI scores between control and intervention groups one month ( $\eta^2_p=0.045$ ,  $P=0.142$ ) and 2 months ( $\eta^2_p=0.019$ ,  $P=0.350$ ) post-intervention. Comparable impact was observed, indicating no statistically significant differences in this outcome measure.

**Gross motor function (GMFM-88) total score and subscale scores)**

GMFM-88 total score: No statistically significant impact on GMFM-88 total scores was identified between control and intervention groups 1 month ( $\eta^2_p=0.009$ ,

$P=0.506$ ) and two months ( $\eta^2_p=0.010$ ,  $P=0.487$ ) post-intervention. Consistency in outcomes was observed across the study duration.

Lying and rolling score: No significant differences in lying and rolling scores were observed between groups 1 month ( $\eta^2_p=0.014$ ,  $P=0.419$ ) and 2 months ( $\eta^2_p=0.013$ ,  $P=0.439$ ) post-intervention. Outcomes remained comparable, suggesting the intervention did not yield significant differences in this aspect.

Sitting score: No significant differences in sitting scores were noted between groups one month ( $\eta^2_p<0.001$ ,  $P=0.904$ ) and two months ( $\eta^2_p<0.001$ ,  $P=0.977$ ) post-intervention. Consistent outcomes were maintained, indicating no significant impact on sitting scores.

Crawling and kneeling scores: No significant differences in crawling and kneeling scores were identified between groups 1 month ( $\eta^2_p=0.006$ ,  $P=0.604$ ) and 2 months ( $\eta^2_p=0.014$ ,  $P=0.411$ ) post-intervention. Similar outcomes were sustained, suggesting no significant impact on crawling and kneeling scores.

Standing scores: No significant variations in standing scores were found between groups one month ( $\eta_p^2=0.007$ ,  $P=0.562$ ) and 2 months ( $\eta_p^2=0.014$ ,  $P=0.418$ ) post-intervention. Consistency in outcomes indicated no significant impact on standing scores.

Walking, running, and jumping scores: No significant variations in walking, running, and jumping scores were observed between groups one month ( $\eta_p^2=0.005$ ,  $P=0.624$ ) and two months ( $\eta_p^2<0.001$ ,  $P=0.914$ ) post-intervention. Consistent outcomes suggested no significant impact on these scores.

## Discussion

This systematic study sought to explore the consequences of group training in handling skills on multiple aspects related to children diagnosed with CP. By examining the domains of gross motor function, functional mobility, and parental capabilities, this investigation contributes to the existing body of literature on interventions for CP.

### Effect of intervention on parental ability

An examination of parental ability reveals nuanced results. Covariance analysis conducted within the first month of intervention initiation indicates no significant differences in the family subscale score between the intervention and control groups. This initial observation suggests limited short-term intervention effects on family subscale scores. However, a noteworthy shift is discernible 1-month post-intervention cessation, with the intervention group displaying significantly higher average family subscale scores compared to the control group. This improvement persists two months post-intervention conclusion, substantiating a sustained positive impact on family subscale scores.

As it was said in the explanation of the concept of the family subscale in the assessment tools section, this subscale deals with the parents' understanding of the child's conditions, the ability of the parents to acquire the necessary knowledge and skills and use them to solve the child's potential problems in the implementation of daily activities and, according to the topic of each of the group training sessions of the present study, in which the participating mothers were taught information about the general conditions of CP, accompanying disorders, how to handle children in each of the frequently used situations of life, it can be seen that after one month of the beginning of the trainings No significant difference was observed in the family subscale between the interven-

tion and control groups, but with the passage of another month after the intervention and the completion of the aforementioned handling training to the mothers of the intervention group, the difference in the family subscale gradually became noticeable and significant. We witnessed a significant improvement in the decision-making ability and effective action of the parents of the intervention group in facing their children's daily situations and problems.

Similar to the family subscale scores, the service systems subscale exhibits no significant differences within the first month of intervention. However, a contrasting picture emerges post-intervention, with the intervention group exhibiting a remarkable increase in scores. This figure exceeds the control group's average scores by 5.7 and 4.1 points, 1 and 2 months post-intervention, respectively, corroborating the positive influence and improvement of service systems subscale scores over time. The community/political subscale demonstrates a similar trend, with significant score increases observed one month post-intervention, persisting over the long term.

The total FES score manifests a considerable increase within one month of intervention initiation in the intervention group, contrasting with the control group. This positive influence persists post-intervention, maintaining statistically higher scores in the intervention group one and two months thereafter.

### Overall impact and long-term efficacy

Totally, the results of this research demonstrate that within one month after the start of the intervention, the average total FES score in the intervention group was significantly higher than in the control group. These findings confirm the positive effect and improvement of the FES total score due to the effectiveness of the intervention. Moreover, the positive impact of the intervention on the total FES score was maintained in the intervention group after the end of the intervention and one and two months thereafter, with the average score remaining significantly higher than the control group.

Overall, the results of this study indicate that the group training intervention of handling skills positively affects parental ability. The effectiveness of this intervention across various FES subscales, including family, service, and social/political systems, suggests that the intervention successfully enhances multiple aspects of family and social life. Additionally, the long-term effectiveness of the intervention has been observed, highlighting the stability of these effects over time.

These findings align with previous research in the field. Lorentzen et al. (2015) demonstrated that interactive educational programs at home can improve parental ability and involvement in the treatment of children with CP [27]. Similarly, Chiu et al. (2014) reached a comparable conclusion [28]. In general, the results of this study, corroborating previous studies, confirm the enhancement of parental ability in children with CP [29-31]. These findings address the need for evaluating the effectiveness of home-based programs, as emphasized by Beckers et al. (2020), who highlighted a strong recommendation for implementing such programs despite the lack of sufficient research [32].

A notable difference between the current study and previous research is the measurement of the long-term effects of training provided to mothers, extending up to two months after the conclusion of interventions. This unique aspect of the study reveals the stability of the training's impact on family empowerment over an extended period, which had not been previously examined. Earlier studies focused on evaluations conducted at the completion of interventions, lacking a long-term follow-up assessment.

#### Effect of intervention on PEDI total score

In assessing the impact of the intervention on the PEDI total score, the study reveals an absence of statistically significant differences between the intervention and control groups within the first month of intervention initiation. This lack of significance persists at 2 months post-intervention initiation, 1 month after the intervention's conclusion, and 2 months post-intervention. These findings suggest a limited impact of the intervention on the total PEDI score during various periods following its implementation, diverging from some previous studies that affirm the efficacy of the neurodevelopmental approach in enhancing occupational performance and addressing feeding and swallowing activities in children with CP [33, 34].

#### Effect of intervention on gross motor function measure (GMFM-88)

The results show that 1 month after the start of the intervention and by controlling the values before the intervention, there is no statistically significant difference between the intervention group and the control group in the GMFM-88 total score. Also, no statistically significant difference was found in 2 months after the start of the study, 1 month after the end of the intervention and 2 months after the end of the intervention.

Regarding the effect of intervention on gross motor function and functional mobility using GMFM-88, similar results have been obtained with PEDI. Here, too, there are differences between the present study and previous studies. It has been reported in some studies that the neurodevelopmental approach and its techniques can significantly improve gross motor function, walking and balance in children with CP [35-38].

However, the results of the present study show that the group training intervention of handling skills did not have a significant effect on the scores of GMFM-88 subscales.

These differences can originate from the difference in conducting the intervention, access to the required resources and equipment, or the special needs of the children under study. There is also a possibility that the interventions provided on the functional mobility and gross movements of children with CP need to be continued and repeated more by mothers at home in order to show their effect. However, it is worth considering the alignment of the results of the present study with the meta-analysis conducted by Velde et al. (2022) who investigated the effectiveness of the neurodevelopmental approach in children and infants with CP or at high risk of CP [37]. This meta-analysis included data analysis of 34 studies, including 1332 participants. The findings showed no significant difference in motor performance between the groups receiving neurodevelopmental therapy and the control group. In other words, the application of the neurodevelopmental approach did not show a significant effect on the improvement of motor performance compared to control interventions. It is worth noting that this study showed that activity-based approaches and interventions that target body function and structure were more effective than neurodevelopmental therapy. These alternative interventions yielded more positive results in terms of improved motor performance. Finally, this meta-analysis provided a strong recommendation against the use of neurodevelopmental therapy regardless of the dose or intensity of the intervention.

The results of the present study showed that group training of handling skills to mothers with children with CP had no significant effect on the functional mobility and gross motor performance of children, but as mentioned in the initial part of the discussion, we witnessed a significant improvement in the ability of the family. Since in the training that was given to the mothers of the intervention group, the handling skills during the execution of the child's daily tasks and the methods of facilitating these tasks for the child were also presented, it can

be concluded that despite the fact that during the study period, there was a significant effect on motor functions. The child has not been observed, but these teachings and their implementation in the home environment have helped to reduce the exhaustion and fatigue of the family in helping as a child's caregiver and have enabled the family to solve problems related to children's daily affairs in a more optimal way. Several studies have been conducted in the field of burden of caregivers or families with children with CP, which show that their caregivers face a lot of physical, mental, and financial exhaustion caused by caring for and helping children with CP in doing their daily tasks [39, 40]. The result of Colak and Kahrman study to measure burden and its related factors on 518 parents of disabled children is consistent with the result of a study conducted by Ozturk and Alemdar with the same aim on 280 mothers with disabled children [41, 42]. Both studies came to the conclusion that while there is attrition that affects caregivers of disabled children, this attrition increases fatigue and decreases the quality of life in caregivers. In continuation of these two studies, another study was conducted in 2024 by Garcia-Grau et al. with the goal of investigating the relationship between the burden of the families of disabled children, their quality of life and self-confidence among 58 families. The result of this study showed that by increasing the self-confidence of families, we can expect an increase in the quality of life and a decrease in their burnout. The family's self-confidence is the family's understanding of its potential abilities in solving problems and implementing its desired affairs; in a way that feels worthy and sufficient [43, 44]. Family self-confidence is the result of the support of health and treatment systems and specialists in this field [43] and this is exactly the same as the "service systems" subscale of the FES that was used to measure the output values of this study and the same As mentioned, the interventions presented in the present study led to improvement in the scores of mothers in the intervention group in this scale and all its subscales. Therefore, the teaching of handling skills to mothers with children with CP during the implementation of the present study did not have a significant effect on the functional mobility and gross motor performance of the children participating in the intervention group compared to the children in the control group, but the mothers who were in the intervention group Compared to the mothers of the control group, there was a significant growth in the ability, self-confidence and self-efficacy of the family, and their fatigue and burden decreased as caregivers of their children. It should also be mentioned that based on the hierarchy of inferences mentioned above, providing the mentioned interven-

tions to the mothers of the intervention group led to an increase in their quality of life.

### Comparative analysis and considerations

Observed discrepancies in the effectiveness of interventions for children with CP across different studies underscore the complexity of evaluation criteria, intervention types, and environmental conditions. The meta-analysis by Velde et al. (2022) further supports the notion that alternative interventions emphasizing body function and structure may yield more favorable outcomes than traditional neurodevelopmental therapy [37]. Future research in this field would benefit from symmetrical and controlled designs to enhance the accuracy and validity of results.

### Conclusion

This study demonstrated that group training in handling skills significantly improved parental abilities of children with CP. The observed positive effects across various subscales emphasize the intervention's effectiveness. Despite variations in study outcomes, factors such as intervention type, duration, and environmental conditions were found to influence results. Conducting future research with symmetrical and controlled designs is crucial for ensuring accuracy and reliability. Notably, the positive effects of the intervention persisted over an extended period following the intervention. This finding underscores the continued support for parents of children with CP. Further research is essential for refining interventions and promoting sustained well-being for both parents and children in this context.

### Limitations of the research

Concluding the thesis discussion necessitates acknowledging and examining the limitations that surfaced during the study, which influence the interpretation and generalization of the results. Given the study's nature and outcomes, these limitations play a crucial role in shaping interpretations and offering recommendations for future research and practical applications. One significant limitation pertains to the study's sampling, as the samples were confined to specific populations under unique conditions. This constraint potentially restricts the applicability of the findings to the broader spectrum of children with spastic CP. Therefore, generalizing these results to other populations must involve careful consideration of this limitation. Furthermore, the study's reliance on standard measurement tools for motor performance and functional mobility, without incorporating a wider

variety of tools, raises concerns regarding the accuracy and comprehensiveness of the results. The absence of diverse assessment instruments may inadvertently introduce bias or overlook certain aspects of the intervention's impact. The failure to control environmental variables, such as the home environment and family support during interventions, adds a layer of complexity to result interpretation. These uncontrolled factors may introduce confounding variables affecting the study outcomes. Consequently, considering these limitations is paramount for the accurate interpretation of the study's results. To address these limitations, future studies are encouraged to involve larger and more diverse cohorts of children with spastic CP, fostering collaboration among various medical and research centers. This approach would deepen the understanding of intervention impacts on this specific group. Moreover, employing extended and longitudinal study designs can facilitate continuous follow-up on interventions, shedding light on their sustained long-term outcomes. In addition, future studies should focus on designing and evaluating interventions tailored to the specific needs and priorities of parents and families of children with spastic CP. By adhering to these recommendations, future research endeavors can take progressive steps in refining interventions for this population, ultimately enhancing their performance and overall quality of life.

## Ethical Considerations

### Compliance with ethical guidelines

This study was approved by the Research Ethics Committee of [Iran University of Medical Sciences](#), Tehran, Iran (Code: IR.IUMS.REC.1401.246). This study was registered by the [Iranian Registry of Clinical Trials \(IRCT\)](#) (Code: RCT20220630055330N1). Informed consent was obtained from all parents or caregivers after receiving detailed project explanations.

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### Authors' contributions

All authors equally contributed to preparing this article.

## Conflict of interest

The authors declared no conflict of interest.

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